

WHAT IS CLAIMED IS:

- 1 1. A wavelength tunable light source, comprising:
2 a resonant light path supporting oscillation of light in at least one
3 longitudinal mode;
4 an optical gain medium disposed in the resonant light path;
5 an optical grating have a grating surface arranged to receive incident light
6 along the light path at an incidence angle relative to the grating surface and to
7 diffract light along the light path at a diffraction angle relative to the grating
8 surface different from the incidence angle;
9 a first acousto-optic deflector arranged to intercept light along the light
10 path, and operable to deflect the intercepted light and to induce a first Doppler
11 shift of longitudinal mode frequencies; and
12 a second acousto-optic deflector arranged to intercept light along the light
13 path, and operable to deflect the intercepted light and to induce a second Doppler
14 shift of longitudinal mode frequencies, wherein the first and second Doppler shifts
15 are in opposite directions.
- 1 2. The wavelength tunable light source of claim 1, further comprising a
2 second optical grating have a grating surface arranged to receive incident light
3 along the light path at a second incidence angle relative to the grating surface and
4 to diffract light along the light path at a second diffraction angle relative to the
5 grating surface different from the second incidence angle.
- 1 3. The wavelength tunable light source of claim 2, wherein the first
2 grating and the first acousto-optic deflector together produce a first optical
3 frequency filter function and the second grating and the second acousto-optic
4 deflector together produce a second optical frequency filter function substantially
5 identical to the first optical frequency filter function.
- 1 4. The wavelength tunable light source of claim 2, wherein the first
2 grating and the first acousto-optic deflector are arranged in a first segment of the
3 light path and the second grating and the second acousto-optic deflector are
4 arranged in a second segment of the light path.

1 5. The wavelength tunable light source of claim 4, wherein the first
2 light path segment substantially corresponds a mirror image of the second light
3 path reflected through a mirror plane.

1 6. The wavelength tunable light source of claim 2, wherein the
2 optically resonant light path is defined between a first mirror and a second mirror.

1 7. The wavelength tunable light source of claim 6, wherein the gain
2 medium, the first grating, the first acousto-optic deflector, the second acousto-
3 optic deflector, and the second grating elements are arranged in order along the
4 light path from the first mirror to the second mirror.

1 8. The wavelength tunable light source of claim 7, further comprising a
2 first half-wave plate disposed between the first grating and the first acousto-optic
3 deflector, and a second half-wave plate disposed between the second grating and
4 the second acousto-optic deflector.

1 9. The wavelength tunable light source of claim 6, wherein the first
2 acousto-optic deflector, the first grating, the gain medium, the second grating, and
3 the second acousto-optic deflector are arranged in order along the light path from
4 the first mirror to the second mirror.

1 10. The wavelength tunable light source of claim 9, wherein the first
2 grating and the first acousto-optic deflector are arranged in a first segment of the
3 light path and the second grating and the second acousto-optic deflector are
4 arranged in a second segment of the light path.

1 11. The wavelength tunable light source of claim 10, wherein the first
2 light path segment arrangement substantially corresponds to a mirror image of the
3 second light path arrangement reflected through a mirror plane.

1 12. The wavelength tunable light source of claim 10, wherein the first
2 light path segment arrangement substantially corresponds to a mirror image of the
3 second light path arrangement reflected through a pair of substantially orthogonal
4 mirror planes.

1 13. The wavelength tunable light source of claim 2, wherein the light
2 path is a circulating light path.

1 14. The wavelength tunable light source of claim 13, wherein the gain
2 medium, the first grating, the first acousto-optic deflector, the second acousto-
3 optic deflector, and the second grating are arranged in order along the circulating
4 light path.

1 15. The wavelength tunable light source of claim 14, further comprising
2 first and second mirrors disposed in the circulating light path between the first
3 and second acousto-optic deflectors.

1 16. The wavelength tunable light source of claim 14, further comprising
2 an optical isolator disposed in the circulating light path.

1 17. The wavelength tunable light source of claim 1, wherein the
2 optically resonant light path is defined between a first mirror and a second mirror.

1 18. The wavelength tunable light source of claim 17, wherein at least
2 one of the first and second mirrors is a retroreflector.

1 19. The wavelength tunable light source of claim 18, wherein the first
2 acousto-optic deflector, the gain medium, the grating, and the second acousto-
3 optic deflector are arranged in order along the light path from the first mirror to
4 the second mirror.

1 20. The wavelength tunable light source of claim 1, further comprising a
2 driver connected to the first and second acousto-optic deflectors and operable to
3 drive the first acousto-optic deflector with a first signal having a first time-varying
4 frequency profile and to drive the second acousto-optic deflector with a second
5 signal having a second time-varying frequency profile substantially corresponding
6 to a time-shifted version of the first time-varying frequency profile.

1 21. A method of wavelength tuning a light source having a resonant
2 light path supporting at least one longitudinal mode and comprising first and
3 second acousto-optic devices for tuning an output light beam over a specified

frequency range with an output wavelength profile, each acousto-optic device inducing a respective Doppler frequency shift of longitudinal mode frequencies supported by the resonant light path, wherein the Doppler frequency shift induced by the first acousto-optic device substantially cancels the Doppler frequency shift induced by the second acousto-optic device, the method comprising:

driving the first acousto-optic device with a first signal having a first time-varying frequency profile; and

driving the second acousto-optic device with a second signal having a second time-varying frequency profile, wherein the second time-varying frequency profile differs from the first time-varying frequency profile by an amount substantially proportional to a time rate of change of the output wavelength profile;

wherein the output light beam is tunable over the specified frequency range without observable hopping between longitudinal modes.

22. The method of claim 21, wherein the first and second time-varying frequency profiles (f_1 and f_2) are give by:

$$f_2 = A + B\lambda + \frac{\alpha}{4} \frac{d\lambda}{dt}$$

and

$$f_1 = A + B\lambda - \frac{\alpha}{4} \frac{d\lambda}{dt}$$

wherein A, B, and α are constants and $d\lambda/dt$ is the time range of change of the output wavelength profile λ .

23. The method of claim 21, wherein the first and second acousto-optic devices are selected from: acousto-optic deflectors; acousto-optic modulators; and acousto-optic tunable filters.